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Hygiene and Disease in Eastern Tropical Africa

The Protection of Aircraft from the Attacks of Insects

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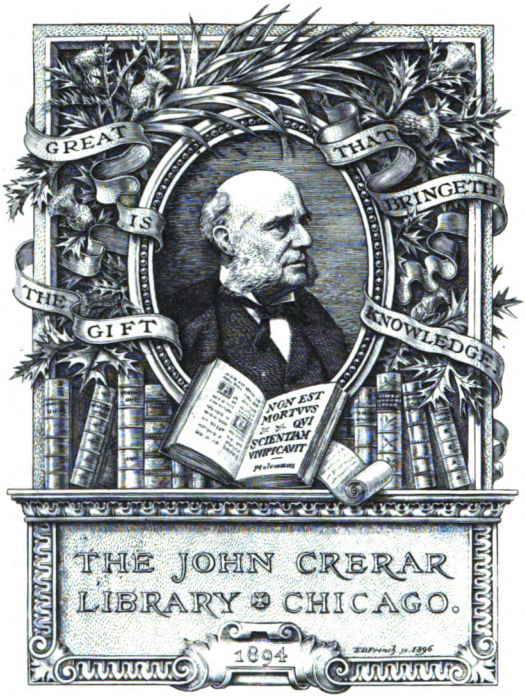
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Hygiene and Disease in Eastern Tropical Africa

The Protection of Aircraft from the Attacks of Insects

ISSUED AS A SUPPLEMENT TO
THE HANDBOOK OF GERMAN EAST AFRICA

Prepared on behalf of the
Admiralty and the War Office

ADMIRALTY WAR STAFF
INTELLIGENCE DIVISION
(No. 1055 A) JUNE, 1916

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NOTE

THESE notes are issued as a Supplement to the Handbook of German East Africa (I.D. 1055).

The section on 'Hygiene and Disease in Eastern Tropical Africa' is intended for the use of officers without immediate access to qualified medical advice or assistance. It includes the whole of eastern Tropical Africa in its scope.

'Insects which attack Aircraft' are chiefly restricted to the tropical regions, but exceptions are noted where they occur.

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I

HYGIENE AND DISEASE IN EASTERN TROPICAL AFRICA [1]

Introductory

Within the last forty years the true causes of many infective diseases have been discovered and proved, and many new methods have been devised to safeguard the health of men suddenly exposed to the risk of tropical diseases. Malaria, yellow fever, cholera, typhoid, dysentery, plague, are at the present time so well understood, and the precautions to be taken against them have been so far worked out, that a man need not be greatly afraid of them—if only he will be careful.

But, of course, he must not only be careful to obey the ordinary rules for the avoidance of infection; he must also be careful to keep himself thoroughly fit and up to the mark. If he impairs his health by any bad habit or excess, or by any neglect of himself, his natural power of resistance becomes less. Proper diet and clothing, avoidance of chill, attention to the teeth and the skin and the bowels, all are of great importance to him. Men ought to be encouraged to believe that, if only they will be careful, they can really do a great deal to protect themselves from infection. For the fear of disease may get more hold on a man than the fear of dying in action. 'Losses in action and losses by disease', says

[1] The following illustrations in this chapter have been taken, by permission, from the works named: Fig. 1, Stephens and Christophers, *Practical Study of Malaria and Blood Parasites* (Williams & Norgate); Figs. 2, 8, 9, 10, 13, 15, 16, 17, 19, Manson's *Tropical Diseases* (Cassell); Figs. 3, 11, Hindle, *Flies and Disease: Blood-sucking Flies* (Cambridge University Press); Fig. 4, Daniels, *Laboratory Studies in Tropical Medicine* (Bale, Sons & Danielsson); Figs. 7, 12, Castellani and Chambers, *Manual of Tropical Medicine* (Baillière, Tindall & Cox); Fig. 18, Alcock, *Entomology for Medical Officers* (Gurney & Jackson); Fig. 20, Daniels, *Tropical Medicine and Hygiene*, Part I (Bale, Sons & Danielsson).

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Lt.-Col. Melville, ' are very different things. . . . Disease takes the heart out of men in a way that mere death on the battle-field does not. I remember well how, in the end of 1898, the Wiltshire Regiment at Quetta lost so many men from enteric fever that recruiting was seriously affected in the home country. They lost about 60 men. I hardly think that the loss of 60 or even 600 men in action would have that effect.'

Our present knowledge of the causes of the infective diseases comes from the work of Pasteur (1822–95) and his followers. It was Pasteur who discovered and proved that the infective diseases are distinct species of microscopic germs, multiplying in the body, and brewing their distinctive poisons in it. He discovered how to isolate the germs of this or that disease, and how to grow them in ' pure culture ', outside the living body, miles away from a patient, all by themselves, in sterilized broth or on sterilized jelly, in a flask or a test-tube. From this discovery came the whole series of discoveries, how to bring down, point by point, the virulence of a pure culture, and how to render man, or animals, immune against this or that disease, by treating them with graduated doses of germs at low virulence, or with doses of the distinctive poisons brewed by germs, or with doses of dead germs, killed by heat or by some antiseptic method, but still retaining their chemical properties.

For example: sheep and cattle are protected against anthrax by graduated doses of anthrax-germs at low virulence. Man is protected against typhoid by graduated doses of dead typhoid-germs. These protective substances go by the name of vaccines, because of their analogy with ordinary vaccination against small-pox; but the name is not well chosen; for neither *vacca*, the cow, nor any other animal, is used in the preparation of these vaccines.

Antitoxins differ from vaccines, for horses are used in the preparation of antitoxins. For example: diphtheria. If a horse be treated with measured doses of a substance brewed by diphtheria-germs in pure culture, the horse becomes immune against diphtheria. Its blood, fighting the poison,

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the 'toxin', manufactures the 'antitoxin', the natural antidote to the toxin. If the serum, the clear part of the blood of this horse, be administered to a child with diphtheria, it will reinforce the antitoxin which the child's own blood is manufacturing, and in this way will help the child to pull through. It can also be used, not to cure a child already attacked by diphtheria, but to immunize a child that has been exposed to diphtheria.

As it is with diphtheria-antitoxin, so it is with tetanus-antitoxin. The germs of tetanus (lockjaw) live in the surface-soil: in dust, gravel, earth, and especially in soil heavily manured. If a horse be gradually immunized against tetanus with small doses of the poison brewed by tetanus-germs in pure culture, its blood is able to immunize a man, or another horse, against the disease. In places where the surface-soil is badly infected with tetanus, a man receiving a wound, with particles of mud or earth got into it, ought certainly to be thus protected, as soon as possible after the injury. The method is used also to protect valuable horses, either after a wound or before some operation of veterinary surgery.

These two discoveries of protection against typhoid and protection against tetanus have saved thousands of lives in the present war.

Pasteur's work, also, inspired Lister (1827–1912) to study the true causes of wound-infection, and to discover the antiseptic treatment of wounds. The date of Lister's first use of carbolic acid, to 'destroy the germs of putrefaction' in a compound fracture, is 1865. That was at the Royal Glasgow Infirmary.

But the discovery how to cultivate and observe, outside the living body, the germs of diseases, led to another grand series of discoveries: it guided the men of science to the present knowledge of the transmission of diseases from animal to animal, or from animal to man, or from man to man, by insects. We know, now, that rat-fleas convey plague from rats to man; tsetse-flies convey sleeping-sickness, lice and ticks and bugs convey relapsing fever, lice convey typhus,

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sand-flies convey sand-fly fever, and mosquitoes convey malaria, dengue, and yellow fever. Just as Nature has told off the dog to be the intermediate host of common tapeworm between man and man, and the fresh-water snail, in Egypt, to be the intermediate host of Bilharzia between man and man, so Nature has told off the *Anopheles* mosquito for malaria, and the *Stegomyia* mosquito for yellow fever. And as the tapeworm has two alternating cycles of life, one in the dog and the other in man, so the germs of malaria have two alternating cycles of life—two elaborate and amazing states of existence—one in the stomach of the mosquito, the other in the blood of man.

Our present knowledge of the ways of transmission of infective diseases has vastly increased our power of protecting ourselves against them. We have left off thinking that they can 'come of themselves'; we have left calling them 'putrid exhalations' or *miasmata*, as if they were no more avoidable than the climate or the weather; we know that they are definite living germs, and that we cannot have the diseases unless we get the germs into us under conditions which suit them. As the saying is, 'You can *eat* cholera, or *drink* cholera, but you cannot *catch* cholera'. We are on our guard against drinking any water that has not been sterilized by boiling, or by chemical treatment, or by both; we know the risk of eating dusty or dirty fruit, and uncooked vegetables, and any food which has been exposed to flies when typhoid or cholera is about. We use mosquito-nets. We reckon body-vermin not only as a great nuisance but as a cause of infective diseases. We understand the right way of dressing sores and wounds, so as to keep them from infection.

But, of course, if a man is careless of himself, or if he is 'run down' by some previous illness, or by exposure, or by intemperance, or by over-fatigue, then the germs take the advantage which he offers to them. For example: there is only one actual cause of typhoid, and that is, the germs of typhoid: but there are many predisposing causes, which mostly may be avoided, if only a man will be careful.

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Some General Rules of Health

There are certain rules by the observance of which the white man in the African tropics may steer clear of disease. The writer spent two periods of about three years each in eastern Tropical Africa,[1] in the midst of many of the diseases discussed below, and owing to the observance of these simple rules, had no illness of any account. He even escaped malaria till right at the end of the second period, though most of his work lay in malarious districts.

(1) **Always use a mosquito net.** This may seem a counsel of perfection. On the one hand, the claims of campaigning may make it appear difficult to carry such an article in one's kit, and on the other hand, there are many places where a net seems, to one unversed in tropical hygiene, superfluous; moreover, in the hotter districts it is unpleasant. To this the reply may be made: a net need not weigh more than 1¾ pounds, and will pack into small compass, and except on high levels, say 7,000 feet or more, there is always risk that a few malaria-carrying mosquitoes may be present, though unobserved, and bite the unprotected sleeper. The net protects the user from the mosquitoes which convey malaria and filarial blood-worms, as well as from snakes and ticks. Native servants will find a means of fixing it up in camp, and this must be done before dark. The edges should be tucked under the mattress, not allowed to hang down to the ground. Care should be taken to kill any mosquitoes which enter with the sleeper—the net should be white and not green, against which colour it is hard to see them. The writer used to read in bed for a few minutes in case a mosquito should make its presence known; if so it was killed, the boy outside the net assisting with a light. No part of the body should rest against the net, which should always be stretched tight. As an added protection for the feet it is wise to wear socks. When holes

[1] By eastern Tropical Africa is here meant the British East Africa Protectorate, Uganda, German East Africa, and the eastern part of Belgian Congo.

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appear, as they are sure to do, the tissue surrounding each should be caught up and tied round with string so as to completely close the aperture; a net with holes is nothing but a mosquito trap, baited with a man. The careful and intelligent use of a mosquito net is the first essential of health in Tropical Africa, and no detail of such use is superfluous.

(2) **Never drink water which has not been boiled** or filtered, whether or not previously treated by a chemical process. To do so is to invite infection with dysentery, typhoid, or in some districts guinea-worm. In almost any part of Tropical Africa fuel can easily be obtained. A good plan for individual use is to have the water boiled overnight, brought for inspection (a very necessary precaution), and, the first thing in the morning, when it has cooled and any suspended matter has settled, put into the water bottles; this was the writer's invariable practice. It must of course be kept carefully covered. No matter how discoloured the water, after boiling it is safe to drink. Filtering is unsatisfactory in the hands of native servants, and in any case filters soon get clogged in Africa; and filtering, *after boiling*, as is sometimes advised, is to be condemned. If no boiled water is at hand in camp or on the road, make tea. If cold water is drunk, it may be freshened by passing through a sparklet siphon or shaken with air in a half-filled bottle.

(3) **Do not eat uncooked food.** An exception may be made in the case of some fruits, e. g. those that can be peeled or thoroughly washed, but not in that of vegetables, fresh salads, and milk, all of which may contain the germs of disease. To eat previously cooked food cold is risky because it may have become contaminated since cooking. All food, cooked or uncooked, must be protected from flies and ants.

(4) **Beware of close proximity to native quarters,** especially at night (Fig. 1). For this reason in all well laid-out stations in Tropical Africa the native quarters are separated from those of the Europeans. The native is a pathological museum. His blood harbours malarial parasites, filarial worms, and, it may be, the germs of sleeping-sickness. Many sorts of worms infest

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his bowel. On his person lice and fleas are frequent guests.[1] The floor of his quarters is apt to be infected with disease germs. Keep him at a distance. For this reason the white man is safer camped far from a native village than near it; the immediate vicinity of the village should always be avoided.

Other precautions are—

Be moderate in eating and drinking.

Inspect the cook's utensils at least once a week.

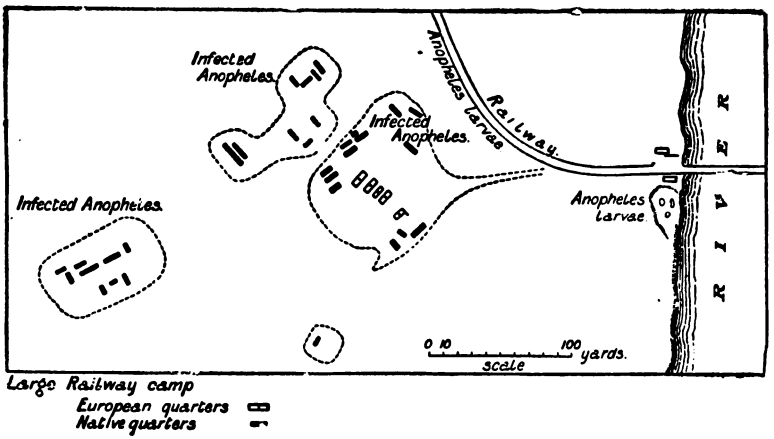

FIG. 1. FIGURE SHOWING HOW EUROPEANS ARE INFECTED WITH MALARIA FROM NATIVE CHILDREN LIVING CLOSE TO THEM.

Avoid alcohol as a rule—it is best not taken except under medical advice, and then only after sundown. It should never be taken between meals.

Wear so-called mosquito boots in the evening, i. e. boots with canvas prolongations which reach nearly to the knee. This protects the ankles from mosquitoes. Gum boots are equally good but are rather hot. In the absence of proper boots, wear two pairs of socks: this baffles the mosquito.

Do not bathe in any pool, however attractive-looking. Granted

[1] The African native is, however, as a rule, a cleaner person than the natives of India who are met with in Africa.

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clothes are worn there should be warmer ones available for the evening, at least at the higher levels where there is often an abrupt fall of temperature about sunset. To remain in clothes soaked with perspiration, which can only dry by abstraction of heat from the body, is to invite chill. Clothes worn next the skin obviously require more frequent washing than in cooler climates. Protection from the sun is referred to under ' Sunstroke '.

Food. The healthy, young, and active man in the tropics can eat the same food and in similar quantities as at home, especially if he is engaged in hard exercise. A warning may here be given as to ' living like the native '. It is sometimes supposed that the white man in the tropics needs less food and of a different kind than at home, and in this respect can adopt native habits. It is not recognized that the native is habitually underfed or rather unsuitably fed, his diet being bulky and not containing the food elements in the right proportion, and that he adopts his diet not of choice but of necessity. It is owing to this and to his disregard of hygiene that he falls such a ready prey to parasites. On expeditions much of the food will come from tins. Swelled or ' blown ' tins should be discarded. When a tin is pierced air should enter rather than come out. The place where the tin was soldered should be looked at, and if there are two soldered places the tin must be rejected, for this means that a dishonest person has doctored a blown tin. It is advisable to eat tinned food promptly, because in a hot climate decomposition may soon set in. It is important, especially when one is living on tins, to have as much fresh food as possible, and to remember that native vegetables are to be had wherever there are natives ; when cooked in the proper way many of these are excellent.

Biting Insects

As many of the more important diseases of the African tropics are conveyed by biting insects some account must be given of those which bite man.

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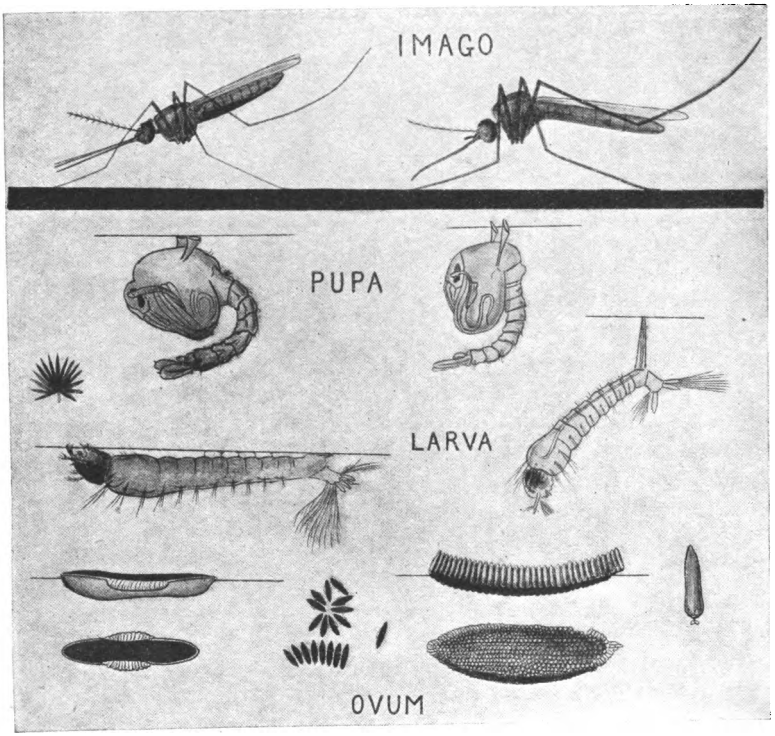

FIG. 3. DIAGRAM SHOWING THE CORRESPONDING STAGES IN THE LIFE-CYCLE OF *Anopheles* (ON THE LEFT) AND *Culex* (ON THE RIGHT).

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Mosquitoes. Mosquitoes are responsible for the transmission of malaria, the most redoubtable disease of the tropics, of dengue fever, and some infections with blood worms. They transmit also yellow fever, but this has not been met with in Africa except on the West Coast. It is in all cases the female of the species which is accountable; the male cannot pierce the skin. The figure shows the appearance of the genus Anopheles, some of the species of

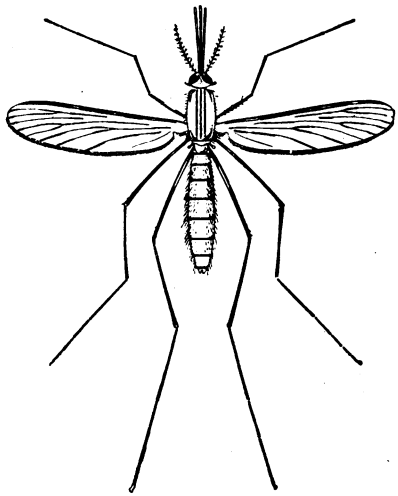

FIG. 2. *Anopheles funestus*, FEMALE.

which carry malaria (Fig. 2). The Anopheles mosquito may be recognized as a rule by three characters: (1) its shape, which is straight, whereas other genera are bent or humpbacked; (2) its position when resting—at an angle with the surface (Fig. 3); (3) its spotted wings (Fig. 4). They breed in streams, pools, and other (natural) collections of water, where the larvae may be found (Figs. 5 (*a*) and (*b*)), and do not as a rule fly far from their breeding-places. Infection takes place thus. The malarial mosquito bites a person with malarial parasites in his blood, it may be a native who

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is to all appearance healthy. The parasites taken in with the blood multiply in the insect and after a few days enormous numbers of infective forms reach the salivary glands. The mosquito is then capable of infecting every person on whom it feeds, large numbers of parasites on each occasion being poured with the saliva into the blood.

Culex fatigans, which transmits dengue and is also one of the chief transmitters of filarial infection, is a domestic mosquito. It is very like the common gnat of England. Its larva is found in water in and around human habitations,

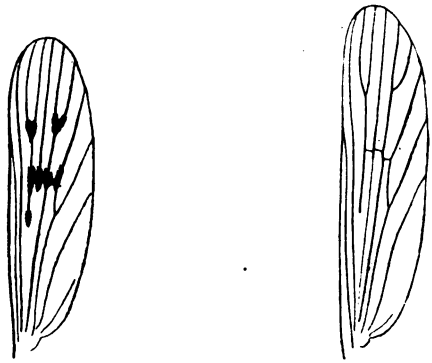

FIG. 4. WING OF *Anopheles* AND WING OF *Culex*.

sometimes even in sewage. The filarial embryos, which this mosquito sucks up with the blood when it feeds on an infected man, develop in the mosquito's body, and eventually infective forms are produced which are injected by the insect into a series of fresh human hosts. Referring to *Culex fatigans*, Colonel Alcock writes :

'Apart from its practical importance, *Culex fatigans* has a peculiar interest as being the living document of two discoveries of the first magnitude in the history of medicine, namely, Sir Patrick Manson's discovery (1879) of the part played by mosquitoes in the life-cycle of certain filarial blood-parasites, and Sir Ronald Ross's discovery (1898 and

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FIG. 5 *a*. BREEDING-PLACES OF ANOPHELINES.

(Flooded Paddy Fields. Shows in the foreground the pools formed by the hoof-marks of cattle; in these Anophelines breed.)

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FIG. 5 *b*. BREEDING-PLACES OF ANOPHELINES.
(Water on each side of the permanent way.)

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1899) of the necessary connection between mosquitoes and certain protozoal blood-parasites. The first discovery laid open a new world to Pathology; the second, which is the outcome of the first, will affect the destiny of the human race.'

As the layman can hardly be expected to distinguish the malaria-carrying and other disease-bearing mosquitoes from the majority of species which are harmless in this respect, it is necessary as far as possible to avoid the bites of all. The most important means is the use of the mosquito net (see above) and the protection of the ankles and legs in the evening. For the comfort, as well as protection, of the officers of an expedition it should be possible to carry one or more large nets, say twelve feet square, suspended by tapes at the top corners from four poles, to serve as a mess-room. The part which touches the ground is weighted with lead. The writer always used such a net. In some parts of Tropical Africa, in the absence of a large net, one is driven to one's bed soon after dark: the net has the further advantage of keeping flying insects innumerable out of the soup. Mosquito-proof tents can also be had. If a camp near to a native settlement is to be occupied more than a few nights, the grass and shrubs should be levelled for, say, fifty to a hundred yards all round. The extent of course varies with the number of men available for the work, and the period for which the camp is to be occupied. The essential oils, which are recommended for personal application to keep off mosquitoes, have been found useful by some. Citronella oil, for instance, may be smeared on the skin in the evening; but it is quite unreliable for protection during sleep, because the oil has evaporated long before the morning. Kerosene oil has also been found effective. The Anopheles seldom bite except when one is comparatively at rest in the evening or in bed at night. The attack may escape notice, for they are silent mosquitoes.

Tsetse-flies, genus Glossina. This fly, of which there are several species, is peculiar to Tropical Africa. They are described as ordinary-looking flies, and are readily to be

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distinguished because the wings project beyond the end of the abdomen and lie over one another like the blades of a pair of scissors, while the long biting proboscis projects in front. One species transmits sleeping-sickness from man to man, and possibly animals to man, and all convey similar diseases to horses and mules, as travellers in Africa have long known to their cost. The sleeping-sickness species, *Glossina palpalis*, is almost black (Fig. 6). It is found at the edge of water where there is shade, hence on the shores of the great lakes and of rivers, but not in swamps; it does not fly far from these situations and as a rule soon returns to the water. It does not occur within 500 miles of the coast of the East Africa Protectorate, nor at a greater elevation anywhere than 4,000 ft.[1] It rarely bites except when the sun is up. This and the other species are attracted by dark colours and attack dark skins more readily than light skins, which is some protection when a white man is accompanied by natives. They feed on any vertebrate animal and live exclusively on blood. Some of the species which are dangerous to domestic animals are met with far from water and at greater elevations than *G. palpalis*. All are slow breeders, but long livers.

To prevent being bitten by these flies, avoid visiting by day places where they are found. The medical officers in charge of troops will see that camp is not pitched close to such a lake or river. Half a mile away no tsetse will be seen unless they have followed water-carriers, or there is much traffic and shrubby vegetation between camp and water. The water must be put out of bounds during the heat of the day for all but natives. If such a camp is to be occupied for long, it is worth while to clear the bank and a strip beyond it of vegetation; the flies will then disappear till growth has recurred. If an infested ford has to be crossed when the sun is up, expose as little bare skin as possible; the flies do not bite through clothes to anything like the same extent as mosquitoes. It is folly to go about in shorts or with shirt-sleeves

[1] For the distribution of tsetse in German East Africa, see map at end of volume.

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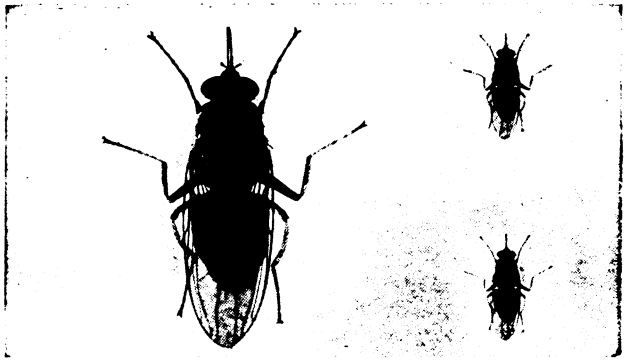

FIG. 6. *Glossina palpalis*, NATURAL SIZE AND ENLARGED.

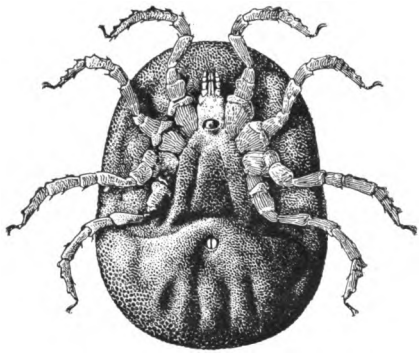

FIG. 7 *a*.

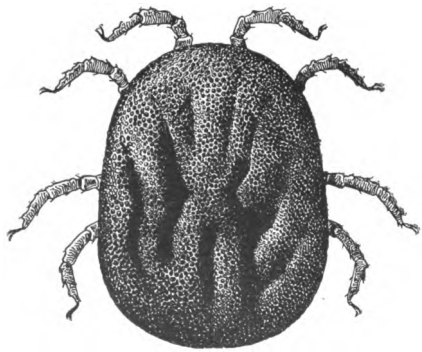

FIG. 7 *b*. *Ornithodorus moubata*, ENLARGED FOUR TIMES.

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rolled up and shirt gaping at the neck where this fly is, at least when it is biting. The only sure way to prevent riding animals being bitten is to avoid the fly areas. If that is not possible, some may be kept away by the vigorous use of branches of trees, and by marching at night the animals may escape attack. By the use of horse-cloths and bandages some degree of protection may be afforded, but the flies will settle unerringly on unprotected spots.

Ticks. Of the numerous kinds of ticks in Tropical Africa only one is known to be dangerous to man, that which conveys tick fever or relapsing fever, *Ornithodorus moubata.* The full-grown tick is an oval eight-legged creature about the size of a split pea (Figs. 7*a*, 7*b*); but the infection in the tick is hereditary, so that recently hatched ticks, the size of a pin's head, if the progeny of infected adults, are also infective and, owing to their small size, more dangerous. This tick has the habits of the bed-bug. It is found under cover in old camping grounds, in the floors of native houses or rest-houses which have been used by natives, or in the walls of such houses, and comes out at night to feed. It is consequently dangerous to sleep in such places, though many natives do so with impunity because previous attacks have made them immune. These ticks can live without food for many months; hence a camping ground which has been long unused may be dangerous. Avoid such places and houses of any kind which have been used by natives. Grass ticks are harmless to man.

Lice. Clothes lice are frequent in eastern Tropical Africa. Every one who lives a camp life gets them sooner or later. They do not appear to transmit any disease-causing parasite in that country (in others they spread relapsing fever), but their mere presence causes much discomfort. There is intolerable itching at night, especially about the abdomen, and the scratching induced may result in troublesome skin lesions. The lice are found by searching the clothes worn next the skin, especially at the seams. It is probable that they can be kept off by wearing little bags containing precipitated sulphur next the skin, or the sulphur may be rubbed into

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the clothes. Naphthaline also has been found useful, and of liquids, kerosene. Infested clothing should be boiled or, if this is impracticable, a hot iron should be passed several times over the seams.

Jiggers or Chigoes. These are minute sand-fleas which are found in great numbers on the unpaved floors of rest-houses and places where natives assemble. They are common too in fowl runs. They are brought into European quarters on natives' feet. It is the habit of the impregnated female to bore her way under the skin of man (and animals), often about the toes; here her abdomen swells up owing to the growth of the eggs therein, till a little bag is produced the size of a pea (Fig. 8). As a rule the part itches, especially in bed at night, but there may be no discomfort at all. For the purpose of picking jiggers out of their feet most natives carry a needle or piece of pointed stick, and it is wise to let a boy examine one's feet every day after the bath and extract any jiggers he finds; in this he is as a rule most skilful, and the number is sometimes surprising. Care should be taken that the instrument is clean. If the jiggers are not picked out, they come away by ulceration, leaving small wounds, which frequently become septic and inflamed, with the possible loss of a toe or worse (Fig. 9). Jiggers may be largely avoided by not walking about with bare feet. Boots and shoes should be kept off the ground. It is said that sprinkling the floor with a strong infusion of native tobacco will keep these pests away.

Fleas. Human and other fleas are common enough in Tropical Africa. As a rule they seem harmless, but as some species transmit plague, which is endemic in parts of eastern Tropical Africa, they should be treated with respect. Cleanliness and insect powders will keep them off. Blankets and bedding should be exposed to the sun's rays every day.

Other biting Insects. There are other insects which bite man in Tropical Africa, some, such as that feelingly called *Simulium damnosum*, such an intolerable nuisance that they drive even the natives from their homes. From such species as that

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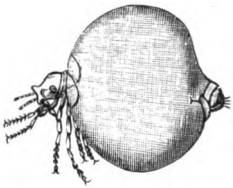

FIG. 8. JIGGER: IMPREGNATED FEMALE, ENLARGED.

FIG. 9. JIGGER LESIONS OF HANDS AND FEET.

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named the only safety is in flight, for they are so small that they can pass through the ordinary mesh of a mosquito net. Only those biting insects which have been shown to transmit disease are considered here.

House-flies. House-flies are found all over the world, and in dirty camps in Tropical Africa may be an intolerable pest. The writer remembers one camp where they so swarmed that he had to go a long distance away to get his meals. The female lays her eggs—120 or more at a time—in rubbish of any kind, especially horse manure, and the adult flies may appear in as short a time as ten days. They are very dirty feeders and, if excreta infected with typhoid or dysentery are about, they are especially dangerous, because after visiting the excreta they may infect food over which they crawl. Flies will not become troublesome if litter about the camp is forbidden. Rubbish and horse-dung should be burned or buried, or at least dumped at a distance. House-flies do not pierce the skin.

Diseases

The chief diseases met with in eastern Tropical Africa are now considered in turn, but it must be remembered that while some, such as malaria and tick fever, are very common and widespread, others, such as guinea-worm and Bilharzia infection, are much rarer and more local. Some, again, are likely to attack numbers of men at the same time, and will therefore be guarded against with particular care in military expeditions. The diseases which are most likely to interfere with the operations of a column are—malaria, tick fever, dysentery, cerebro-spinal meningitis, and perhaps typhoid.

Malaria.[1] The disease of the African tropics which causes the most disability. It has been stated that the amount of incapacity caused in the tropics by malaria is greater than

[1] An admirably clear account of this disease is contained in Sir Ronald Ross's *A Summary of Facts regarding Malaria suitable for Public Instruction*, published by John Murray, price 2*d*. All persons going for the first time to the African Tropics should get this pamphlet.

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that due to all other causes combined. It is usually known as 'fever' from its most prominent symptom, but a person may suffer severely from the effects of malaria and have little or no fever—merely anaemia, loss of energy, irritability, perhaps diarrhoea, &c. People who have had much malaria, attended or not by fever, are liable to be attacked by the still more serious disease blackwater fever (see below); this is another reason why malaria should be avoided.

Malaria is due to the presence in the blood of minute, one-celled parasites, only visible under a high power of the microscope, which are introduced, usually at night, by the bite of certain species of mosquito (Fig. 10). The parasites, invading the red blood corpuscles, multiply therein, and, after a shorter or longer interval, produce the symptoms; and unless the

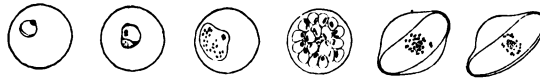

FIG. 10. PARASITE OF MALARIAL FEVER WITHIN THE RED CORPUSCLE, MUCH MAGNIFIED.

man is treated in the first attack promptly, vigorously, and for a sufficient time, the parasites will lurk in his system for years. There are two kinds of parasites, as the figure shows. Some multiply in the red corpuscles and the new cells so formed escape to attack and occupy others. The other kind, having reached a certain stage, do not develop further unless they are taken up by a suitable mosquito host. The mosquito sucks up the latter parasites from infected persons (these parasites are peculiar to man); hence the danger of living in close proximity to natives, especially native children, who are usually infected though they may appear healthy. The parasites, moreover, are not merely passed on from man to man, but multiply enormously in the mosquito, which remains capable of infecting every person it bites during a period of many weeks (Fig. 11). In a standing camp a man who has not been adequately treated is a danger to his fellows, for he infects any susceptible mosquitoes which feed upon him.

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FIG. 11. SPOROZOITES OF MALARIA FROM THE SALIVARY GLANDS OF *Anopheles costalis*, MUCH MAGNIFIED.

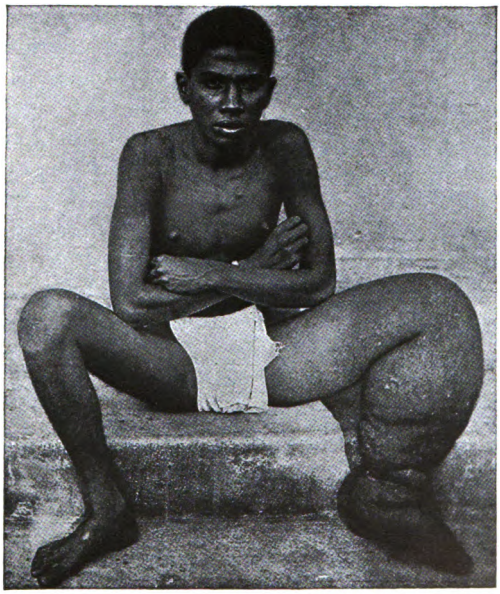

FIG. 12. ELEPHANTIASIS OF THE LEG.

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An attack of malaria is popularly considered to have three stages—a cold stage (ague), a hot stage, and a sweating stage followed by an intermission, or freedom from fever, of one or two days. This is the case in the simple forms, tertian and quartan, which occur in many parts of the world, but it is not so as a rule in the malaria met with in eastern Tropical Africa. Here there may be merely a chilly feeling with lassitude and pain in the limbs. The temperature may be high and remain high, and vomiting may be troublesome. It is not possible to give an account here of the many forms the disease may take. Any old tropical resident who gets a rise of temperature says he has 'fever', meaning malaria, and takes quinine. It is often impossible, however, from the symptoms to distinguish malaria from fevers due to other causes; a microscopic examination of the blood is alone decisive. Hence people in Africa should learn from a doctor how to make a thin smear of blood on a piece of glass for subsequent microscopic examination, and they should make the smear before they dose themselves with quinine.

To avoid malaria, take all possible precautions against being bitten between dusk and daylight by mosquitoes, and, at least in known malarious districts, since it is often impossible to escape a few bites, take quinine, which kills or prevents the development of the parasites in the blood. The first measure is by far the more important. By the regular and careful use of a mosquito net one may live for years in malarial districts, as did the writer, without getting malaria. Quinine alone is quite untrustworthy, but forms a second line of defence to the first—the avoidance of infection. If large numbers of parasites are being frequently introduced into the blood, the quinine has little chance of being effective; if, however, the number of parasites which get in is reduced to a minimum by mechanical protection, the quinine may prevent their development. There are many ways of taking quinine. The plan of swallowing a five-grain tabloid of one of the soluble salts (e.g. the bihydrochloride) daily is probably as good as any, but it is advisable to take two or three such

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tabloids at intervals one day a week, say on Sundays. To ensure regularity, which is essential, the quinine should be taken at the same hour every day ; the writer took his when he sat down to dinner. It is wise to dose one's servants also. Note that when one has an attack of fever it is useless to swallow sugar-coated tabloids ; they do not get dissolved in the stomach as in health ; the tabloids must be broken up and taken as a powder, or, better still, the quinine given in solution or by injection.

When a man gets an attack of fever which he thinks may be malaria, supposing that he cannot have the services of a doctor, he should go to bed, take a blue pill or 3 to 5 grains of calomel followed in three hours by a dose of Epsom salts and 5 grains of quinine every six hours, if possible in solution. He may not be able to keep it down. If he remains quiet in bed, however, he will not take harm till the doctor gets to him, and indeed the fever will probably leave him after a few days, to reappear later ; it is hardly possible for people with malaria in Africa to treat themselves efficiently, though they may initiate the treatment. It is well here to emphasize the importance of continuing the quinine after the fever has disappeared, even though the attack was a slight one. If this is neglected, relapses are sure to occur. The minimum period for which quinine in decreasing doses (in excess of the daily 5-grain dose) should be taken is three weeks, and some authorities lay down a still longer minimal period.

Blackwater fever. This dreaded disease is seldom seen in Tropical Africa except in persons who have been some months in the country and have suffered from malaria, and by no means all such persons get it. After some unusual exertion or exposure, as a rule, the patient feels out of sorts, takes perhaps a dose of quinine (he is generally an irregular quinine taker) and a few hours later has an attack of shivering and is alarmed to find he is passing black water. He must at once go to bed and get medical advice. If he is young and in good condition and is carefully nursed, he will probably get well. In this disease the red corpuscles, whose function

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is to carry oxygen to all the cells of the body, become broken up in the blood, the colouring matter or haemoglobin being passed through the kidneys. The result is great weakness and a danger of suppression of urine, owing to blocking of the kidneys with cell débris.

The prevention of blackwater is the prevention of malaria. Avoid being bitten by mosquitoes after dusk and take quinine regularly, and you need have no fear of getting blackwater fever. As, however, in expeditions a man sleeps where and how he must rather than where and how he would choose, and hence may not succeed in avoiding malaria, stress must be laid on the importance of care in malarial attacks. Never neglect them and persist in getting about; the right place for a man with malarial fever is bed. It is well known in Tropical Africa that blackwater fever is a sequel of neglected malaria, and Dr. J. Howard Cook informs the writer that he has seen many cases of blackwater set in after the patient has thrown off the bed-clothes in the hot stage of the fever or has taken a cold bath too soon in convalescence. [See note, p. 46.]

Filaria Infection. A condition in which the embryos of a filarial worm are found in the blood. Some kinds of filaria are harmless, but others (*Filaria bancrofti*) are the cause of elephantiasis (Fig. 12). The parent worms are introduced into the blood by the bite of several species of mosquito, and their introduction is prevented by the avoidance of mosquito bites. Once they are in the body treatment is useless.

Dengue. This is a fever lasting about a week, from which recovery practically always occurs. The pains in the limbs are so severe that it has been called 'break-bone' fever, and in typical cases there is a rash on the skin. It is spread by a species of mosquito (*Culex fatigans*), and when it breaks out in a community very few persons escape. The nature of the virus is unknown.

Tick Fever. Malaria, dengue fever, and filarial infection are diseases which are spread exclusively by mosquitoes. Tick fever, known also as relapsing fever, is, as its name implies, spread by a tick. It is common in some regions of eastern

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Tropical Africa, unknown in others. Its distribution is dependent on that of the tick which transmits it, and this again largely depends on the position of the caravan routes. The tick, *Ornithodorus moubata*, bites at night and introduces into the blood minute parasites known as spirochaetes (Fig. 13). The victim often does not know that he has been bitten, but about a week later he has a sharp attack of fever, which he probably takes for malaria. After about five days the fever leaves him and he is well for 7 to 10 days, when he gets another attack of fever like the first, and this again is followed by a third, a fourth, and perhaps a fifth attack with corresponding intervals, so that the total course of the disease may be many weeks. Finally he may get paralysis of one

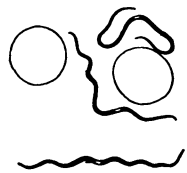

FIG. 13. SPIROCHAETES OF TICK FEVER: TWO BLOOD CORPUSCLES SHOWN.

side of his face or inflammation in his eyes, and have to be invalided out of the country. If, however, he has medical treatment, including perhaps an injection of salvarsan, the disease may be cut short. Quinine is useless.

Freedom from tick fever is secured by the avoidance of the special tick which conveys it. Shelters in old camping-grounds, native houses, rest-houses, &c., are dangerous, and if a number of susceptible persons—and all Europeans are susceptible—sleep in such places, one and all may be helpless with tick fever in a week's time.

Sleeping-sickness. A disease peculiar to Africa conveyed by the biting fly, *Glossina palpalis*. It is caused by the presence in the blood of minute animal parasites called trypanosomes (Fig. 14), which, once established in the system, may end the patient's life in six months, three years, or perhaps a good deal later. The fly sucks up the trypano-

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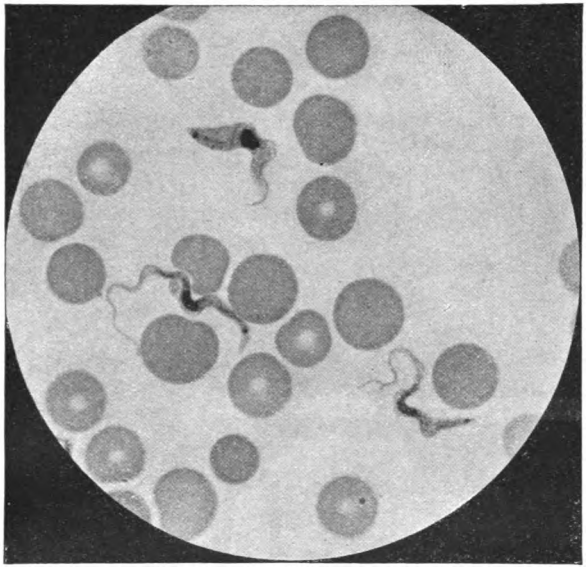

FIG. 14. THE HUMAN TRYPANOSOME MAGNIFIED 1,000 TIMES: THREE SEEN AMONG THE RED BLOOD CORPUSCLES.

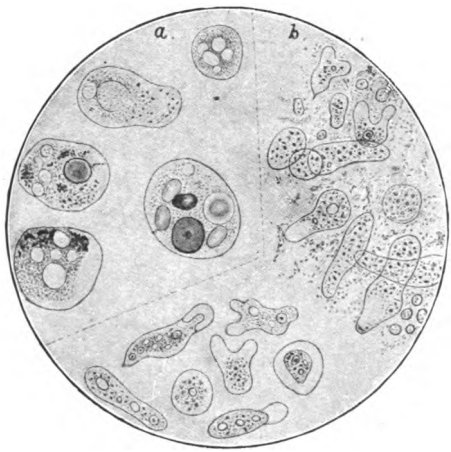

FIG. 15. THE AMOEBA OF DYSENTERY AS SEEN UNDER THE MICROSCOPE.

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somes from the blood of an infected man or, possibly, animal. The trypanosomes multiply in the fly for many days or even weeks, then reach the salivary glands, and thereafter are injected into every man or animal the fly bites during the rest of its life, which may be six months or more. Within a fortnight of the bite the man has an attack of fever, which is usually taken for malaria, and after that may suffer from irregular attacks of fever alternating with periods of comparatively good health. Later he may get enlargement of the glands in the neck, and in the last stages the drowsiness from which the disease derives its name. If the nature of the disease is detected early, and this is only possible by the recognition of the parasites in the blood or lymph, the patient can be treated and has some chance of recovery.

To avoid sleeping-sickness avoid being bitten by *Glossina palpalis*. This is the more easy because the fly is restricted to water where there is shade, only bites when the sun is up, and is restrained from bites to some extent by clothes. Moreover, even in places where the disease is common, only a small percentage of flies is infected. Sleeping-sickness was widespread and very fatal in that portion of the Uganda Protectorate which borders on the Victoria Lake, until the cause and the means of transmission were discovered (1903). The natives were then all removed a few miles inland and no fresh infections have occurred among them since.

There is another form of human trypanosome infection, met with in German East Africa between Lake Nyasa and the sea, north of the Rovuma river; this form has not been reported from any other part of the colony, but occurs across the Portuguese frontier as well as in Nyasaland and Rhodesia. It is spread by *Glossina morsitans*, a tsetse which has a wide distribution and is found far from water in country lightly covered with shrubs or small trees. *G. morsitans* covers large areas in British, as well as German East Africa, but, except in the districts mentioned, its bite appears to be harmless to man. As a rule, where this form of the disease is found, big game is numerous, and many of the victims have

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been infected on hunting expeditions. It is still more dangerous than the better-known form; cases of recovery have hitherto been very rare.

Plague. This disease has long been known in certain parts of British East Africa, German East Africa, and Uganda. It has been stated that the whole district adjoining Lake Victoria must be regarded as plague-infected as far as the rats are concerned; several human cases have occurred on the lake steamers. It is primarily a disease of rats, being conveyed from rat to rat by the rat-flea. The rat-flea leaves the dead rat and, supposing other rats are not at hand, attacks man, with the more chance of infecting him because the virus may retain its vitality in the flea for at least 15 days. Rats may also infect food and so man. Plague is caused by the presence in the system of a minute bacillus, which is injected by the flea. The most common form the disease takes is the bubonic, in which there is a large and painful swelling of a group of glands, usually those of the groin, with fever and prostration. A still more dangerous form both to the patient and his attendants is the pneumonic, in which the symptoms are those of pneumonia. Plague is unlikely to occur in camp unless pitched near an infected village. It will be avoided by not pitching in the vicinity of villages in one of the areas known to be infected, and by keeping the camp in a clean condition with no food accessible, so that rats have no inducement to visit it.

Undulant or Malta fever. This fever, which gets its second name from its having been first recognized in Malta, is widespread in the African tropics, though not very common. It is due to a minute bacillus which is found in the milk of apparently healthy goats and, less commonly, in other domestic animals. It is a chronic fever of long duration, accompanied by rheumatic-like pains and anaemia. It may last many months. It is contracted from drinking the milk of infected goats and possibly cows, and it may be in other ways, e. g. from the dust of the dried excreta of infected animals contaminating food or water. Given its presence in the goats of

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a district, undulant fever is easily conveyed to the native because the goats share his hut. It is dangerous to drink unboiled goat's or cow's milk, and the possibility of infection from milk products, such as butter, should be kept in mind.

Typhoid fever or enteric fever was a few years ago rare in eastern Tropical Africa, but is becoming more common. It is avoided by care of food and drinking-water. There is always danger of its introduction into a community of white men living in close association, because some persons who have at one time had the disease continue to harbour the bacillus after their recovery and pass it in their dejecta at intervals for many years. A cook who is a ' carrier ', as such people are called, may unwittingly, even though fairly clean in his habits, infect many people. There are many instances of such an occurrence. Persons proceeding to Tropical Africa should be inoculated against typhoid.

Cerebro-spinal Meningitis. This disease is met with in Tropical Africa chiefly on comparatively high ground. It occurs in epidemics, which may spread rapidly in large camps with a high mortality. It is due to a bacillus which invades the nose and from there gains access to the membranes which enclose the brain and spinal cord, and it appears to be spread by ' carriers ', for the bacillus can be found in the noses of persons who are themselves healthy.

' When meningitis is known to be about, every " cold " should be looked on with suspicion and any one suffering from a " cold " should use antiseptic gargles and nasal douches. Particular attention should be paid to handkerchiefs, which should be frequently changed, promptly boiled, and never, as is sometimes done, used for anybody else.'

Leprosy. This disease is fairly generally distributed over eastern Tropical Africa, but does not appear to be anywhere common. It is due to a bacillus, but how this gains access to the body is uncertain. In its earlier stages it cannot be recognized except by a doctor. As infection does not occur except as a result of long and close association with a leper, it is hardly necessary to consider the disease further.

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Dysentery. The diseases hitherto considered have been well-defined affections due to the presence in the tissues of one sort of minute animal or vegetable organism in each case. The term dysentery covers several diseases having different causes, and merely means a condition in which the stools contain blood and slime and are passed in small quantities with painful straining. Of these various affections the two most important forms are amoebic dysentery (Fig. 15) and bacillary dysentery; both occur in eastern Tropical Africa, the former being probably the more common. Amoebic dysentery may be followed, sometimes after many years, by abscess of the liver. The dysenteries are contracted by the drinking of water containing the bacilli, or amoebae in cystic form, which have reached it from human faeces, or by the contamination of food by flies, or of food or table utensils by the hands of infected persons who themselves may show no signs of the disease; for both forms are spread by 'carriers', mentioned above under Typhoid. Dysentery is avoided by the taking of suitable precautions for the care of food and drinking-water; it is not so easy for the individual to protect himself against servants who are 'carriers'. Drinking-water should be boiled. Food should be protected from flies. Uncooked vegetables should not be eaten. Amoebic dysentery may be arrested by injections of emetin, combined with other suitable treatment. Bacillary dysentery is treated by serums. For the prevention of dysentery in a community the proper disposal of excreta is all-important.

It should be remembered that dysentery may start as a simple diarrhoea, and that such a patient may have an amoebic infection of his bowel without ever passing blood. Diarrhoea should never be lightly regarded in Tropical Africa. The patient should rest, have little food and that of an easily digested character, and, if the flow does not cease in a few hours, take an ounce of castor oil with a few drops of chlorodyne. Even when blood is passed these simple measures may suffice.

Small-pox is a common disease in Tropical Africa. It is very

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infectious and is much feared by the natives. In any large assembly of natives many pitted faces will be seen. The disease is guarded against by efficient vaccination. All Europeans should be revaccinated before they proceed to the African tropics ; there is no room there for the conscientious objector.

Bilharzia Infection. This disease is due to the presence in the veins which go to the liver of certain blood-worms called Bilharzia. It is not common in the interior of eastern Tropical Africa. The eggs are laid in the small veins of the bladder or rectum and make their way into one or other of these viscera, to be discharged with the urine or faeces. They are detected in the excreta by microscopical examination. In each case chronic inflammation is caused, as the eggs are irritating, and bleeding, as shown by the presence of blood in the excretions. When the blood is passed with the motions the symptoms suggest dysentery. In the case of blood passed with the water it usually comes with the last drops. The disease is very common in Egypt, and the eggs have been found in mummies of the 20th Dynasty. The Bilharzia worm spends part of its existence in man and part in a water-snail ; both are necessary to its life-cycle. Infection is acquired by bathing in water containing infected snails, the snails discharging into the water minute forms which bore through the skin of man ; the snails derive their infection from the embryos contained in the eggs passed by man in or near the water, and thus infection passes from man to snail and snail to man. If one does not bathe in such water one does not get Bilharzia, but it may possibly be acquired by drinking water infected by the snails. Water which is heated for the bath is harmless because the minute worms are destroyed. There is no cure for this condition, which may last many years.

Guinea-worm Infection. This disease is common in a few districts of eastern Tropical Africa. The worm, one or many, is found immediately under the skin. As a rule there are no symptoms of its presence, though it may be 30 to 40 inches

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long (Fig. 16), till a blister appears, often about the ankle. This breaks and a little opening is seen at the base, from which the end of the worm may protrude. When the part is bathed white fluid gushes out, which is seen under the microscope to consist of embryo worms (Fig. 17). The

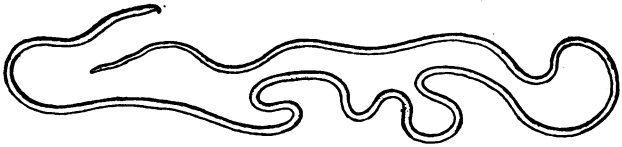

FIG. 16. GUINEA-WORM.

FIG. 17. GUINEA-WORM SEEN IN TRANSVERSE SECTION TO SHOW EMBRYOS.

disease is acquired by drinking of water in which there are certain minute crustaceans, called Cyclops (Fig. 18). The worm spends part of its life in the Cyclops, and when one of these is taken into man's stomach the worms escape from the Cyclops and bore their way through the stomach wall. About a year later the adult female worm or worms, full of embryos, appear under the skin. The embryos invade the Cyclops's tissues when an infected native bathes or washes his sore in

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water containing the crustacean. Straining the drinking-water through muslin is sufficient to filter off the Cyclops, but boiling is of course better. To cure the disease the worm must be got away, but rough measures are worse than useless because the worm is slender and easily breaks, when an abscess usually results. The disease is seldom dangerous, but may lead to much disability.

Ankylostome or Hookworm Infection. The hookworms are

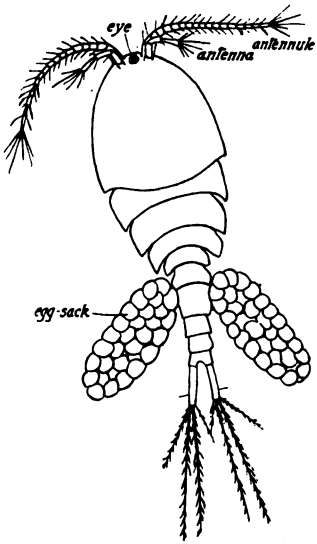

FIG. 18. FEMALE CYCLOPS, ENLARGED.

thread-like worms about half an inch long, which live in the small intestine (Fig. 19). They attach themselves to the mucous membrane and suck the blood, and if numerous bring about anaemia and loss of energy. They discharge eggs at intervals, which may be found in the faeces. The disease spreads through fouling of the ground with infected excreta. The African walks barefoot over the infected soil and the embryo worms bore through his skin, eventually reaching the intestine;

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as a rule he shows no sign of ill health. The disease is uncommon in Europeans owing to their cleaner habits and the wearing of foot-gear. This insidious disease is recognized by the discovery of the eggs of the worm in the faeces. The worms can be expelled by suitable treatment, but care must be taken against reinfection.

Prickly Heat. The next three diseases are troublesome skin affections. Prickly heat is an eruption of minute papules, or papules with shining vesicles, which itches intolerably; it is associated with profuse sweating. The waist, back, chest, arms, and forehead are commonly affected; that is, those parts where perspiration is freest. If the victim scratches he is liable to introduce micro-organisms and to get boils. The treatment is to keep cool, if possible, and to

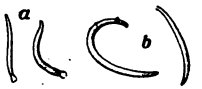

FIG. 19. ANKYLOSTOMES, NATURAL SIZE.

drink little. The clothing must not be too warm. A solution of salicylic acid in alcohol makes the best application, followed by a boracic powder, e.g. equal parts of boracic acid, zinc oxide, and starch. Such a powder should be applied after the bath.

Dhobi's Itch. This unpleasant skin disease is a raw condition of the crutch and inner sides of the thighs with almost unbearable itching. Scratching may result in eczema, boils, or abscesses. It is due to a microscopic fungus. It is so called from the belief that the disease is conveyed by clothes returned from the native washerman or 'dhobi'. The disease may become chronic and last a long time. It is very resistant to treatment and a doctor must be consulted. The boracic acid powder mentioned above should be used after the bath. The disease disappears if the patient goes to a temperate climate or to a high altitude in Africa, but may reappear when he comes back.

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FIG. 20. CHILD WITH YAWS.

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Whether the dhobi is responsible for this disease or not is uncertain, but it is well to see that one's clothes are not washed in a dirty pool together with the washerman's own; they are usually dried in the sun, which tends to kill any germs of disease upon them.

Scabies or Itch is a skin disease which is very common in the African Tropics. It is caused by the invasion of the skin by a mite, is spread by close contact with infected persons, and is cured by the application of sulphur ointment after a hot bath. The native well knows the value of sulphur ointment for this condition.

Yaws is a common disease amongst natives of eastern Tropical Africa, but is rarely seen in Europeans (Fig. 20). It is a chronic contagious disease manifested by papules and ulcerations of the skin, and is allied to syphilis.

Venereal Diseases. Syphilis and gonorrhoea occur in eastern Tropical Africa as in other parts of the world. Their local prevalence varies much. Among some native tribes they are rare, amongst others common enough, and at the larger European centres there are always many infected women. These diseases, if contracted in the tropics, lead to much disability, far more than in temperate climates. Moreover, infected persons fall an easier prey to malaria and other parasitic diseases.

Sunstroke or Heatstroke. There are different views as to how this condition comes about. When a man takes hard exercise his temperature rises and would continue to rise unless he gave off heat from the skin by radiation and by evaporation of sweat. These processes bring the temperature to an equilibrium, neither rising nor falling. If now the sun or surrounding air is excessively hot and one or more of the following factors is present—overcrowding, muscular fatigue, absence or an insufficient supply of drinking-water, insufficient circulation of air, high relative humidity checking perspiration —the loss of heat is insufficient and heatstroke or heat prostration may result.

In heatstroke there is dizziness, headache, and somnolence,

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accompanied in serious cases by a big rise of temperature. The skin is hot and dry. There may be coma or convulsions, and of cases in which these occur one quarter die. In heat prostration there is giddiness, pallor, weak pulse, and perhaps syncope. The temperature is not raised.

The more serious form of heatstroke will not be treated with any chance of success except by a doctor. Ice-packs, if ice is available, venesection, and introduction of salt solution into a vein offer the best hope. Such a condition may be, and probably often is, due to malaria, so that it is wise to get quinine into the blood as quickly as possible, by injection into a vein or the rectum, both procedures that require skill. There is rarely time for a blood examination.[1] In the milder forms of heatstroke rest in the shade or in a cool room with cold applications to the head and light diet will be sufficient, with later the administration of calomel followed by salines. Naturally the patient must not be subjected to the old conditions again for some time. In heat prostration the treatment is that for faintness. Put the patient on his back in the shade. Loosen the clothing about the neck and chest if necessary. Dash some water in his face. Give a little stimulant.

To guard against sunstroke or heatstroke the factors listed above must be avoided as far as possible. The head must be protected, at least at the lower levels, by a well-ventilated pith helmet. It is sometimes advised that the helmet be lined with red or orange coloured material to filter off the actinic rays, but there is no evidence that this is of value. The writer during his service in Africa never saw a case of heatstroke of any kind (he was in the interior), but he never met any one who had adopted the orange-lining precaution. A pad is recommended to be sewn on the shirt where it covers the spine. It is advisable to be clad lightly and loosely during a march, and to rest in the shade when

[1] Exposure to the sun undoubtedly brings on malaria in a malarious subject. Old residents who get fever and have been exposed to the sun say they have a 'touch of the sun'.

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the sun is hottest. While a lack of water conduces to heat-stroke or heat exhaustion, every man should school himself to drink as little as possible on the march or at least to postpone his first recourse to the water-bottle. Persons who are suitably clad, are not deprived of water, and are in good health and temperate as regards alcohol, are not likely to suffer from the sun.

The list of diseases seems already long, but there are two others which should be mentioned: cholera and typhus fever; typhus has not occurred in eastern Tropical Africa, and cholera not since 1871, but either might at any time be introduced.

Cholera. Cholera is an acute disease which occurs in epidemics, is caused by a bacillus, and is characterized by violent purging and vomiting, cramp, and collapse. It may lead to death in a few hours. It spreads direct from man to man or is conveyed in drinking-water. By cleanliness, the boiling of water, and strict care of food it may be avoided. There was an epidemic of cholera in Zanzibar in 1912, but it did not spread to the mainland.

Typhus. Typhus is a fever which is spread by lice. It is a disease of temperate rather than hot countries, but might well spread in the uplands of Africa if it were introduced. It is prevented by measures for the extermination of lice.

Snake-bite. In the writer's experience this is uncommon in eastern Tropical Africa, but venomous snakes are not rare. In the event of a snake-bite of a limb, a ligature should be applied as soon as possible, and must be twisted so as to control the circulation. Long and deep cuts must then be made, laying the wound well open, and a strong solution of permanganate of potash (3 per cent.) applied, so as thoroughly to wash it out. A small case has been devised (by Sir Lauder Brunton) containing a lancet for making the cuts and permanganate crystals for the solution (Fig. 21); when there is no opportunity to make a solution the crystals may be rubbed in. The ligature is removed after some 20 to 30 minutes'

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application, the patient kept warm, and alcohol given in small doses. In the case of snake-bite of the head or trunk the ligature must be dispensed with.

Scorpion Sting. The scorpions met with in the region under consideration are, as a rule, small and not very common. They are found in the Upper Nile district, usually under flat stones, and it is in moving such stones that one is attacked. The sting is painful, but rarely dangerous. It may be treated by ligature and permanganate of potash in the same way as snake-bite, or (a sufficient measure in most cases) 5 to 10 minims of a 5 per cent. solution of cocaine may be injected under the skin close to the puncture. This soon relieves the aching.

FIG. 21. INSTRUMENT FOR TREATMENT OF SNAKE-BITE, &c.

Ulcers and Boils. Ulcers about the legs and ankles are not infrequent in white men in eastern Tropical Africa. Their starting-point is a slight injury or insect bite which is neglected. The habit of going about with bare legs disposes to such injuries. The ulcers should be kept clean and covered with a dressing, either boracic ointment on clean rag or a wet dressing of 1 : 1,000 perchloride of mercury.

Boils may occur on any part of the body, and in Tropical Africa are not necessarily a sign that a man is 'run down'. They should be kept covered and, when they discharge, the dressing should be of an antiseptic fluid, such as perchloride, kept wet. To prevent reinfection from the matter which comes away and the formation of fresh boils, the skin around should be carefully disinfected.

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Distribution of Diseases

The data are insufficient to give in any detail the geographical distribution in eastern Tropical Africa of the diseases which have been briefly described.

Malaria and blackwater fever, dysentery and typhoid, small-pox and scabies may be met with anywhere.

Malaria. The distribution of malaria depends in the first instance on that of the malaria-carrying species of mosquito, but relapses are very common, so that it may be met with anywhere in Africa and, as is well known, the patient may suffer from it at intervals for many years and long after he has left the country. Moreover malarial mosquitoes are very widely spread in the inhabited areas of Tropical Africa.

Dysentery and *Typhoid* are water-borne or fly-borne, or depend on the presence of infection in apparently healthy comrades or in attendants.

Tick fever is not often met with away from native towns or villages, or caravan routes. Otherwise it is widely distributed, and with increased travel is enlarging its bounds.

Sleeping-sickness is restricted to the shores of the great lakes—Victoria, Albert, Edward, Tanganyika, including their islands, and to rivers which flow into or out of them—the Nile and its tributaries, the Congo and its tributaries, &c. (We are not here concerned with the West Coast.) It is not contracted at a greater altitude than 4,000 ft., the upper limit of *Glossina palpalis*. It does not occur on rivers which drain to the coast of German and British East Africa. Another form of this disease is found in Songea in German East Africa (see above, p. 31).

Filaria infection. Infection caused by *F. bancrofti* (other species are harmless or of less account) is more common on the coast and the banks of the large rivers than elsewhere.

Plague is endemic at Nairobi in British East Africa (and perhaps Mombasa), between Voi and Taveta, and in several districts in the neighbourhood of the Victoria Lake, e.g. Kisumu, Mwanza, Southern Buddu and Kisiba, Busoga and

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cotton-growing districts to the north. It has also occurred near Iringa in German East Africa, on the upper waters of the Ruaha river, and on the eastern slopes of Kilimanjaro.

Guinea-worm is found on the Upper Nile below the Albert Lake, and possibly elsewhere. It appears to be very rare south of the Equator.

Bilharzia infection is stated to be very prevalent at Massassi in the Lindi District of German East Africa.

Ankylostome infection is generally distributed, but most in the coastal regions.

Undulant fever has been found in Uganda, and is probably present elsewhere in eastern Tropical Africa.

Yaws is one of the commonest diseases among the natives, and is widespread.

Cerebro-spinal meningitis has occurred epidemically in the higher parts of the East Africa Protectorate.

Food Supplies in Eastern Tropical Africa

In most parts of Tropical Africa in the region of the great lakes, and between these and the east coast, local food supplies suitable for Europeans may be obtained, though in the case of a large body of white troops the resources might be quickly strained if not exhausted. It would be impossible for any one who was not familiar with British and German East Africa, Uganda, and the eastern part of Belgian Congo—and the writer is familiar with one only of these countries—to write in authoritative detail on this subject. In what follows the reader should bear this in mind, and note that the remarks have no more than a general application. As regards the numbers of the persons to be supplied organization should make up for local scarcity.

In some parts of these countries, especially the higher levels where tsetse-flies are few or absent, there are large herds of cattle, and it is unusual to find a district in which no fresh milk can be had. The arrangements for milking should be supervised, as, apart from ordinary uncleanliness,

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it is a common practice to wash the vessel which is to catch the milk with the cow's urine. Excellent butter is, or was a few years ago, made in one district near the Victoria Lake. Sheep and goats are found everywhere, but not usually in great abundance. If goat's milk is used it must be boiled. In some districts guinea-fowl are very plentiful. Fowls, small and skinny, are kept in every village, and eggs, a small percentage eatable, can usually be had. Excellent fish is plentiful in the large lakes and rivers, and is caught by the natives. It would be out of place in this work to write of big game, but in the case of expeditions numbering a dozen Europeans fresh animal food is rarely lacking.

Sweet potatoes are very generally grown, and other native vegetables, of which peas and beans are the most nutritive. Ground-nuts, of which there are extensive plantations, make excellent soup. European potatoes and other vegetables of temperate climates do well at the higher levels, but would rarely be grown in sufficient quantity. There is plenty of native flour, but the native way of grinding it—between two stones—introduces so much grit that not every European can digest it. Moreover it will not 'rise' in the baking, so that it must be eaten in the form of chupatties. Probably native corn is now ground in the larger centres by more modern methods. The steamed plantains which are the staple diet of some African tribes are found unpalatable by most white men.

Of native fruits in the interior there are only the banana and papay, but others, such as the mango, have been introduced, especially near the coast Excellent coffee is grown on the shores of the Victoria Lake. The native boys cook fairly well, with what appear to be very inadequate appliances. Given a camp fire, a large metal vessel, and imported flour, they make excellent bread.

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APPENDIX

Note on the Treatment of Blackwater Fever

Dr. J. Howard Cook, of the C.M.S., Uganda, has very kindly furnished the following account of the treatment of blackwater fever :—

1. Every patient must immediately be put to bed and jealously guarded from exposure to the least chill, as a chill almost certainly increases the haemoglobinuria and may cause fatal suppression of urine—one of the most dreaded complications of the disease. Hence cover the patient with blankets, give him (during the cold stage) hot bottles, hot diluent drinks, &c. And give an early dose of 3–5 grains of calomel with a dose of effervescent Mag. sulph., or other saline, to check griping. This is the 'initial treatment'.

2. *Collect and measure all urine passed, and put out separate samples from time to time to judge of colour, deposit, &c.* Taking the normal output of urine to be 50 oz. and on very light diet to be, say, 30 oz. in 24 hours, if the quantity passed progressively drops off, regard this as a danger signal and at once supply hot fomentations to the loins and give hot diluent drinks, tea, barley-water, lemon-juice, &c. ; also a mixture (Mist. Diuretica). Best of all—this for the doctor's use—is a combination of Diuretin gr. x, Pot. cit. gr. xx, and Aq. menth. pip. to ℥ i, whilst Pituitrin is exhibited internally by hypodermic injection. Note also the great value of rectal, subcutaneous, or intravenous injections of saline (teaspoonful to 1 pint of water). This might be given rectally by an unskilled person with a Higginson syringe every 8 hours. I have seen this save life.

3. Give a mixture (Hearsey's) made of ordinary washing soda and liq. hydrarg. perchlor.

Thus—Washing soda gr. xv.
Liq. hyd. perchlor. ♏ xxx.
Aq. ad ℥ i.

The liq. hydrarg. perchlor. is made from
1 soloid corrosive sublimate (8·75 grains, Burroughs Wellcome & Co.)
1 pint of water.
= 1 : 1,000.

This is of the same strength practically as liq. hyd. perchlor. of the British Pharmacopœia and 30 drops of above solution may safely be given in each dose of Hearsey.

4. Watch the pulse, and if it gets weak, or rapid or irregular, give Champagne ℥ ii three times a day or oftener, or Brandy ℥ i in water.

5. If vomiting is troublesome, try (*a*) a mustard plaster to epigastrium—often quite efficient. Put two tablespoonfuls of dry mustard and two tablespoonfuls of flour in a teacup and make into a stiff paste with water, smear on a piece of lint or paper, and apply direct to the epigastrium and leave on for 10–15 minutes, and then apply vaseline. (*b*) If that fails, then give Tr. iodine 1 drop in a teaspoonful of water every quarter of an hour for 8 doses (= 2 hours). This nearly always succeeds. (*c*) A Bismuth mixture may with advantage be given, e. g.

℞ Sodii bicarb. gr. xx.
Bism. carb. gr. xv.
Mucilage acaciae q. s.
Aq. menth. pip. ad ℥ i.
t. d. s. a. c.

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6. The Hearsey's mixture is given every 2 hours for first 24 hours, then every 3 hours till urine clears, and for 24 hours longer. Then give an iron tonic.

7. Keep the temperature charted accurately, and measured every 4 hours, and whenever a rigor supervenes. If temperature runs up, the patient must be sponged with tepid water without undue exposure, and a diaphoretic mixture given, e. g.

℞ Sp. aeth. nitrosi ℥ xv.
Pot. nitratis gr. xv.
Liq. am. acetatis ʒ ss.
Aq. ad ℥ i.
4 hourly.

Antipyretics, such as phenacetin, &c., are dangerous.

8. When the haematuria has cleared give quinine on Koch's method (hydrochloride). Thus, 1st day, gr. ½ (morning); 2nd day, gr. ½ morning, gr. ½ evening; 3rd day, gr. 1 morning, gr. ½ evening, &c. (increasing gr. ½ each day till full dose of gr. v thrice a day is reached, and then decreasing gr. ½ daily till the prophylactic dose is reached).

9. The risks of blackwater fever are—

(1) Hyperpyrexia; for treatment see paragraph 7.

(2) Suppression of urine; for treatment see paragraph 2.

(3) Heart failure—due primarily to loss of blood-pressure. Hence keep all patients with blackwater fever absolutely recumbent, and see that micturition, defaecation, &c., take place in this recumbent attitude. One has known of several cases who have fallen back dead after sitting up suddenly.

10. After convalescence warn patient against cold baths. I've known many a relapse so induced. A strong healthy man need not necessarily be invalided home to Europe after an isolated attack. After relapses, or in older or debilitated subjects after first attack, he should be sent home when fit to travel.

11. *Diet during blackwater fever.* During febrile period nourishment must be liquid, and easily retained. If vomiting is very obstinate, give rectal feeding, viz. peptonized milk or meat suppository every 4 hours, alternating with peptonized milk enema (if milk obtainable). To peptonize use zymine powders or other peptonizing agent. Bowel should be washed out every evening with a pint or so of boracic lotion during rectal feeding.

If fluid can be retained by mouth (and it generally can if the Iodine treatment be given as a preliminary and a mustard plaster applied to pit of stomach), then either milk or albumen water or buttermilk, or each in turn, may be given.

Milk. 2 pints at least to be given in the 24 hours, in divided doses every 2 hours, i. e. at least 3½ oz. every 2 hours.

Albumen water equals milk in nutritive value, and hence is given in same doses, viz. 2 pints in 24 hours. Made from whites of 3–4 eggs (5 African eggs), shaken in 1 pint of cold or tepid water in a bottle, and a little sugar or lemon-juice added.

Buttermilk is often taken and liked when ordinary milk is too heavy. Can always be obtained from any station where cows are kept.

Give plenty of diluent drinks—soda-water, lemonade, barley-water as extras. This is important, as it flushes out kidneys and skin, and prevents suppression of urine and lowers temperature.

When temperature drops, gradually improve diet on ordinary rules.

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II

THE PROTECTION OF AIRCRAFT FROM THE ATTACKS OF INSECTS.

Insects

The insects which are liable to do important damage to a finished aeroplane or to stores of spare parts may be divided into two groups : (1) wood-boring beetles, and (2) termites or white ants.

Wood-boring Beetles.

The ordinary furniture beetles (*Anobiidae*), whose ravages are so well known in Europe, do not occur in the hotter parts of Asia or in Africa south of the Sahara, their place being there taken by an allied group, the *Bostrychidae*. In adaptation to their mode of life the Bostrychids are characteristically cylindrical in shape, many of them appearing as if abruptly cut off with a knife at the tail end, and they range in size from one-sixteenth of an inch to insects over an inch long and thicker than a lead pencil, their colouring being generally reddish brown or black.

Many of the smaller species are highly destructive to most local timbers, but in ordinary circumstances imported woods are not much liable to attack. If, however, aeroplanes are stored in sheds made of unseasoned local wood, the Bostrychids attracted to the latter might subsequently turn their attention to the machines in the shed.

The beetles of the genus *Lyctus* are more likely to be of importance in this connexion. These are small, elongate insects of a reddish brown colour, measuring from one-eighth to one-quarter of an inch ; they are proportionately longer, narrower, and flatter than any of the Bostrychids, and some-

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what resemble the small brown beetles often found in flour. One of the species, introduced in foreign timber, has of recent years become a serious pest in England, especially in oak, ash, and walnut. The same insect is known to occur in Asia and Tropical Africa, and it is therefore not unlikely that those portions of aircraft that are made of ash may be attacked by it, though hitherto there has been no actual record of any injury done by *Lyctus* in the Tropics. It is improbable that it would touch the parts that are made of spruce. Even in the case of those woods which it specially affects, a marked preference is shown for sapwood, heartwood being very rarely damaged.

In Southern Europe and Asia Minor there are, in addition to *Lyctus*, only three beetles which do any serious damage to seasoned timbers, namely, *Anobium domesticum*, *Anobium pertinax*, and *Xestobium tessellatum*. The species of *Anobium* will feed on most of the European woods, and spruce and ash would be readily attacked. They are small, uniformly brown insects, a quarter of an inch or less in length, and are very similar in appearance to *Anobium paniceum*, which is probably a much more familiar object, being a not infrequent inhabitant of Army biscuits. The *Xestobium* is hardly likely to be of importance, as its principal food is oak (the roof of Westminster Hall is riddled with it) and less frequently chestnut, other woods being rarely attacked. It is much larger than *Anobium*, being over half an inch long and of a dark brown colour, mottled with grey.

As a general rule these wood-boring beetles are not active in daylight, except perhaps in dark or sheltered places; nor is a machine likely to be attacked by them if it is in regular use and being constantly cleaned. A coat of varnish alone will afford some measure of protection, and there should be little danger of injury from this cause if all the woodwork of the aeroplane is well rubbed over, at intervals of not less than a week, with any preparation containing a good proportion of either turpentine or paraffin. Care should be taken to rub the mixture well into any cracks or joints, especially where the canvas is attached to the frame.

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It may be noted that these beetles never make an entry into a piece of wood on an exposed surface; this is always effected inside a joint or in some similarly protected cranny. The shot-hole apertures on the exposed surface of infested timber are not entrance holes, as is often supposed, but indicate the places where the beetles bred in the wood have emerged. If, therefore, even a single hole of this kind is found in any part of an aeroplane, the member should at once be removed and replaced by a sound piece of wood, for it will probably be discovered that the internal injury is already considerable.

The adequate protection of spare parts kept in store may present greater difficulties. The most satisfactory method would doubtless be to treat all wooden accessories before shipment with one or other of the preservatives or insecticides to which reference is made later. If this is not feasible, a useful expedient would be to sprinkle with a liberal supply of powdered naphthaline the contents of all packages containing goods liable to be damaged as they are brought into the base store. (Incidentally it may be mentioned that it is most advisable that a good stock of naphthaline should always be available; for not only is it the cheapest and most effective remedy for lice, when it is impossible to pass the infested clothes through a proper stove, but it is also most useful as a temporary deterrent for termites, fever ticks, &c.)

With regard to the canvas used for the wings, it is very improbable that this will be eaten by beetles on the aeroplane itself, nor is it even likely that any rolls kept in stock will be touched. But as a matter of precaution, it would perhaps be advisable occasionally to shake a little naphthaline into the rolls.

Termites.

In the Tropics these insects are likely to prove a much more serious danger than any of the wood-boring beetles, for whenever they find a substance that is suitable for food, they can summon such large numbers to the attack that

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the damage effected even in a single night is often astonishing. In such countries, wherever the soil is capable of supporting vegetation, it will be wise to assume that there will be termites underground, even though no external signs of their presence can be detected, and articles made of leather, cardboard, or wood should never be left lying on the ground at night.

In the countries adjoining the Mediterranean only two species of termites occur, one of which has occasionally done a certain amount of damage to buildings, but it does not seem to be a really serious pest.

With very few exceptions, all the wingless (asexual) members of the termite community are blind. Their heads are hard and shiny, of a reddish or yellowish brown colour, while the rest of the body is soft and dirty white or grey. The wingless forms are divided into two castes, soldiers and workers, the former being distinguished by their much larger heads and powerful jaws; the workers do the actual damage, while the soldiers stand round with open jaws to protect them from possible foes. In habits the workers are almost entirely nocturnal, and on their foraging expeditions the advancing column is always protected by a mud tunnel, which is constructed as they go along, there being a continual procession of workers bringing up mud pellets from the rear for the purpose. They will not advance over any place which necessitates a break in the tunnel, and this peculiarity affords us a useful means of checking them.

The mere raising of a machine to a foot or more off the ground on supports which the white ants will not eat will reduce the risk of attack, but cannot be relied upon as a real protection if the insects can build their tunnels up the supports. Thus the wheels of an aeroplane may serve as a means of approach, although neither they nor their tyres (termites will not touch rubber) will be damaged; while the backstay, being usually made of ash, is more than likely to invite attack.

If it is desired to protect an aeroplane merely for a night

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or two under a temporary shelter, it would be advisable to provide for a ground-sheet of rot-proof canvas upon which the machine can stand; and if this sheet can be made continuous with one side of the shed, so much the better. This specially prepared canvas is not touched by white ants; but if the sheet be kept too long in one position, the insects will sooner or later work over one of the edges and thus get access to the machine. If naphthaline or any other disinfectant is available, sprinkling the ground with it beneath the sheet would be an advantage. If no temporary shed or ground-sheet is likely to be available, it would be well for the machine to carry three pieces of rot-proof canvas, each a few feet square, which could be placed under the wheels and back-stay at night, and would reduce the chances of attack, especially if a ring of powdered naphthaline were placed round the base of each support.

In a base camp it will probably be more economical in the long run to erect the sheds on termite-proof stands. The most satisfactory method of attaining this would be to have the sheds raised on brick pillars, sufficiently high to enable the ground underneath to be kept cleared of vegetation. When the pillars have been built to about two-thirds of their intended height, a sheet of zinc should be inserted, of such a size that it will project for two inches clear on every side, and then the brick-work should be continued above it. The floor joists should be painted with two coats of one of the recognized preservatives. For access to the shed a sloping gangway would have to be constructed, which must be removed at night, so that all communication between the floor and the ground is cut off by the zinc plates; for the termites have great difficulty in building their tunnels on the lower surface of the zinc, and it is quite impossible for them to build round the sharp edge.

If it is impossible to obtain bricks or freestone, the piles would have to be made of timber (preferably imported) which has been soaked for at least twenty-four hours in a 10 % sodium arsenite solution or in 'Atlas' Preservative, and

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the projecting zinc plates would have to be inserted in the same way.

An alternative, but less satisfactory, method would be to make a simple cement floor on the ground-level; but this would require constant watching, for the white ants would be certain to build over the edges before long.

In the case of a store for supplies it is even more important that the shed should be effectively isolated on pillars, for when full of goods it would be impossible to inspect it adequately for white ants, and probably serious loss would have taken place before the insects were detected.

The appearance of their earthworks is usually the first indication that termites are present, but they can sometimes be detected by ear when they are working quite out of sight. This is due to the fact that when danger threatens, the soldiers give warning to the workers by rapping their heads sharply (rat-tat-tat-tat, repeated several times) on the floor, which is equivalent to sounding 'the retreat', for the workers at once hurry back underground as fast as they can. When this pattering sound is heard, a search should at once be made for white ants.

Preparations for preserving Timber

From time to time many substances have been recommended as effectively protecting timber from the attacks of insects and fungi, but in few cases have these preparations been submitted to a searching test. A few years ago, however, in the Transvaal some experiments of this nature were carried out. Woods susceptible to injury by termites were treated with a number of different preservatives, being soaked in them for twenty-four hours, and then exposed for three years in places where they would be liable to attacks of these insects. The only preparations which afforded effective protection throughout this time were: Arsenite of soda, 10 % solution; Atlas Preservative, full strength; Atlas Preservative, 10 % solution; Demuth's Dip, 10 % solution; Cooper's Dip, 1 pint to 9

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gallons water ; and Alderson's Dip, 4 lb. to 8 gallons water ; all of which contain soluble arsenic. Similar protection was afforded by a saturated solution of copper sulphate, and also by two coats of full strength Atlas Preservative applied with a brush ; this latter preparation, supplied by the Atlas Preservative Co., Windmill Lane, Deptford, has also been favourably reported on in India. The cheapest of all these substances is the arsenite of soda, and this is probably the active constituent of all the proprietary articles.

Railway sleepers impregnated with creosote have been found to resist the attacks of termites for a considerable time in India and West Africa. Soaking in carbolineum at 150° F. or painting the wood with two coats at the same temperature has also given very satisfactory results.

Another mixture which is likely to prove useful is a solution of naphthaline in carbon tetrachloride, but this has not yet been tested on any comprehensive scale.

The Utilization of Local Timbers

Our information as to the capacity of exotic timbers in resisting insect pests is at present extremely limited, and so far as termites are concerned, competent authorities incline to the opinion that it is not safe to assume that any wood is absolutely immune to their attacks. And even if such a timber can be found, its use in the construction of a shed will not of itself protect the contents of the building. This can only be effected by preventing the termites from getting any access to the floor, and, as explained above, that can best be attained by raising the floor on piers intersected by projecting plates of zinc.

If this method be adopted, it will then only be necessary to provide against injury by wood-boring beetles.

As a general rule indigenous timbers are more liable to attack by local insects than are imported kinds, and as in the countries to which these notes apply it would probably be difficult to obtain a supply of seasoned local timber, green woods would

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have to be used, and these are usually more attractive to insects.

In the case of temporary sheds it may be doubted whether the damage caused by wood-boring beetles is likely to be of any serious consequence, for it would be a good many years before the structure would be rendered in any way unsafe as a result of their depredations, provided that sound wood is used in the first instance. From a practical point of view the most satisfactory method would probably be to utilize any woods that are readily accessible and easily worked, and to treat these with some cheap preservative. The insecticides which would be likely to be most suitable are: sodium arsenite, hot carbolineum (150° F.), and chlorinated naphthaline. It is true that the green woods will probably not absorb the chemicals to anything like the same extent as seasoned timber, but they would certainly take up enough for the purpose. Immersion in the liquid would perhaps be the most convenient method of treatment, but the hot carbolineum will be almost equally effective if two coats are applied with a brush.

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